

Number: **E-04-005**

Date: **April 16, 2004**

ENGINEERING DIRECTIVE

Thorse F. Broderick

CHIEF ENGINEER

CANTILEVER RETAINING WALLS

Effective immediately, the 1996 Metric Edition Construction and Traffic Standard Details and the 1977 [English Edition] Construction Standards are amended with the following new drawings (attached):

Typical Cantilever Retaining Wall Section 305.1.0 Cantilever Retaining Walls - Dense Foundation Soils, Sloping Backfill 305.2.0 Cantilever Retaining Walls - Dense Foundation Soils, Level Backfill, 305.3.0 Surcharge 305.4.0 Cantilever Retaining Walls - Loose Foundation Soils, Sloping Backfill Cantilever Retaining Walls - Loose Foundation Soils, Level Backfill, 305.5.0 Surcharge 305.6.0 Cantilever Retaining Walls - Rock Foundation, Sloping Backfill Cantilever Retaining Walls - Rock Foundation, Level Backfill, Surcharge 305.7.0

These drawings may be used on any applicable project, effective immediately. For projects designed in Metric units, dimensions and quantities shown on these drawings shall be converted to logical Metric units with the approval of the Projects Division.

If Cantilever Retaining Walls are used, the contract documents shall include Special Provisions that describe the work, location(s) and any known geotechnical information that indicates the nature or strength of the foundation material(s).

The Resident Engineer shall confirm that the design parameters are appropriate based on actual field conditions. If no geotechnical information is available, the Resident Engineer should request assistance from the Geotechnical Engineer prior to authorizing construction of the wall(s). In these cases, the Geotechnical Engineer shall determine the foundation condition(s). Discrepancies regarding foundation conditions shall be resolved through consultation between the Resident Engineer, the designer, the contractor and the Geotechnical Engineer.

All cement concrete shall be placed in accordance with the requirements of Section 901. Cement Concrete Masonry and shall meet the material requirements of Section M4.02.00 Cement Concrete. All reinforcing steel shall meet the material requirements of Section M8.01.0 Reinforcing Bars.

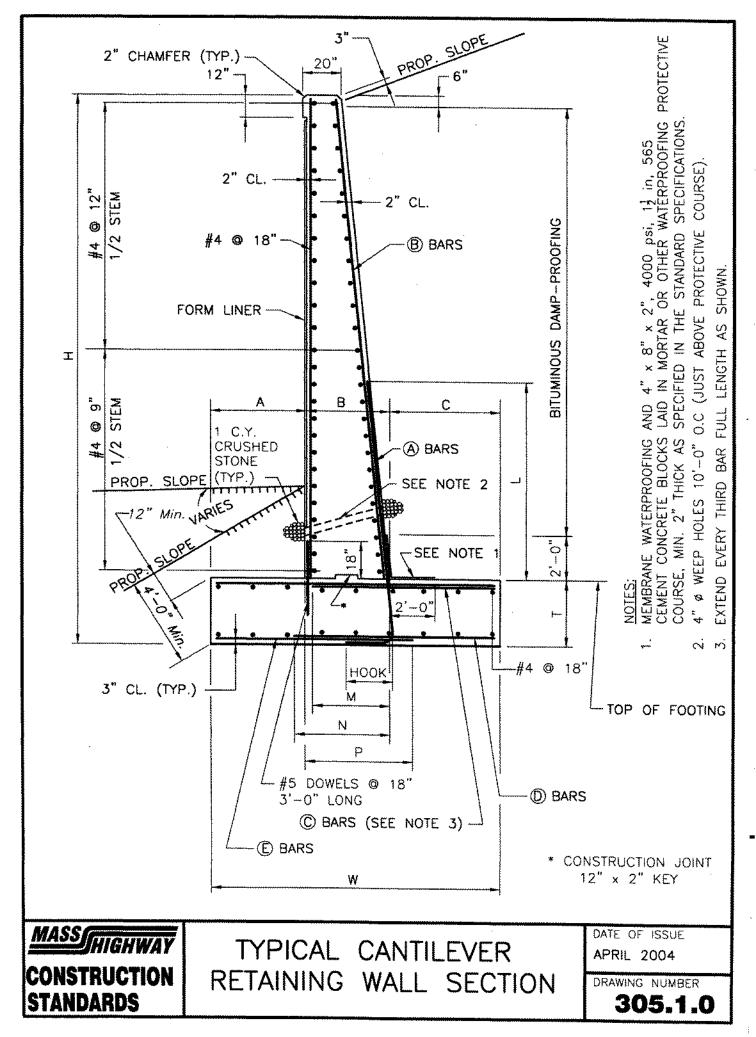
Cantilever Retaining Walls shall be estimated and bid using the following items:

693.	Concrete for Wall Footing	Cubic Yard, Cubic Meter
694.	Concrete for Wall Stem	Cubic Yard, Cubic Meter
695.	Reinforcing Steel	Pound, Kilogram

Payment under these items shall include compensation for all necessary labor, equipment and materials to complete the work to the satisfaction of the Engineer. Necessary weep holes shall be included under Item 694. Necessary form liners shall be paid under a separate item, unless specified otherwise.

Excavation shall be paid for at the contract unit prices under Item 141. Class A Trench Excavation or Item 144. Class B Rock Excavation. Payment under these items shall include full compensation for all necessary shoring or sheeting. Backfilling shall be paid for at the contract unit price under Item 151.2 Gravel Borrow for Backfilling Structures and Pipes. Bituminous Damp-Proofing shall be paid for at the contract unit price under Item 970. Bituminous Damp-Proofing.

Attachments:



DENSE FOUNDATION ス

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1	Н	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0	29.0	30.0
I	W	8.500	9.000	19,000	10.500	11.000	12.000	12.500	13.000	13,500	14.000	15.000	15.500	16.500	17.500	18.000	19.000	20.000
ı	T	2.000	2.000	2.000	2.000	2.000	2.000	2.500	2.500	3.000	3.000	3,500	3.500	4.000	4.000	4.500	4.500	5.000
ı	A	1.500	1.500	2.000	2.000	1.500	2.000	2.000	2.000	2.000	2.000	2.500	2.500	3.000	3.500	4.000	4.500	5,000
П	8	2.500	2.583	2.667	2.750	2.833	2.917	2.958	3,042	3.683	3.167	3.208	3.292	3.333	3.417	3.458	3.542	3,583
H	С	4.500	4.917	5.333	5.750	6.667	7.083	7.542	7.958	8.417	8.833	9.292	9.708	10.167	10.583	10.542	10.958	11,417
H																		
П	L.	3.600	3.900	5.600	6.000	8.000	8.500	8.750	9.250	9.500	12.000	12.300	12.900	13.200	13.800	14.100	14,700	15,000
H	M	1.917	2.500	3.167	4.083	5,000	6.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5,000	5.000	5.000	5.000
Ш	N	1.000	1.000	1,000	1.000	1.250	1,250	1.250	1.250	1.250	1.500	1.500	1,500	1.917	1,917	1.917	1.917	1.917
Ш	₽	1.000	1.000	1.250	1.250	1.000	1.250	1.250	1.250	1,250	1.250	1.250	1,250	1.500	1,917	1.917	2,500	2.500
1	HOOK	1.000	1.167	1.167	1.333	1.333	1.583	1.583	1.833	1,833	1.833	2,000	2,000	1,583	1.583	1.583	1.583	1.833
ı																		
ı	A bars	6@12	7@12	7@12	8@12	8@12	9@12	9@12	10@12	10@12	10@12	11@12	11@12	9@6	9@6	9@6	9@6	10@6
ı	B bars	4@12	4@12	4@12	4@12	4@12	4@12	4@12	4@12	4@12	4@12	4@12	4@12	4@12	4@12	4@12	4@12	4@12
ı	C bars	7@18	8@18	9@18	10@18	11@17	11@14	11 @ 15.5	11@13	11 @ 13.5	11@12	11@12	11 @ 10.5	11 @ 10.5	11 @ 9.5	11 @ 10.5	11 @ 9.5	11@9.5
ı	D bars	4@18	4@18	4@18	4@18	5@18	5@18	5@18	5@18	5@18	6@18	6@18	5 @ 18	7@18	7 @ 18	7@18	7@18	7@18
ı	E bars	4@18	4@18	5@18	5@18	4@18	5@18	5@18	5@18	5@18	5@18	5@18	5@18	6@18	7@18	7@18	8 @ 18	8@18
ľ																		
I	Quantities of Materials												į					
ı	Stem Concrete (yd 3 /ft)	0.9	1,0	1.1	1.2	1.3	1.4	1.4	1.6	1,6	1.7	1.8	1,9	2.0	2.1	2.2	2.3	2.4

Stem Concrete (yd ³ /ft)	0.9	1,0	1.1	1.2	1.3	1,4	1.4	1.6	1.6	1.7	1.8	1,9	2.0	21	2.2	2.3	2.4
Footing Concrete (yd3/ft)	0.6	0.7	0.7	0.8	6.8	0.9	1.2	1.2	1.5	1.5	2.0	2.0	2.5	2.6	3.0	3.2	3.7
						·											
Steel (lb/ft)	98	117	152	171	200	233	243	280	292	399	454	470	488	510	524	550	631

Maximum Soil Bearing Pressure

0 (000	F400	****	F100	CAPI					2.22			2255		222		20.10	
$Q_{max}(pst)$	5123	5663	5432	5954	7019	6759	7346	7886	8482	9033	8817	9355	9178	8984	9103	8948	8892
	5		1	Ĺ				,	1		1	,		;	,		37
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Notes:

- 1. All dimensions are in feet, unless specified otherwise.
- 2. Spacings of reinforcing bars are in inches.
- 3. Designer must confirm design parameters with Geotechnical Engineer prior to selecting wall for site.

ASSUMED DESIGN PARAMETERS

DENSE FOUNDATION SOIL, SLOPING BACKFILL



3. FOUNDATION SOIL PROPERTIES:

5. REINFORCED CONCRETE:

2H:1V SLOPING BACKFILL

q, # FACTORED BEARING CAPACITY = 9400 psf

F_C = 4000 psi

FRICTION FACTOR = 0.57

F_V = 60000 psi

2. BACKFILL SOIL PROPERTIES:

\$ PERFORMANCE FACTOR FOR SLIDING = 0.80

TYPE: GRAVEL BORROW FOR BACKFILLING STRUCTURES AND PIPES

4. SEISMIC LOADING:

8 = ANGLE OF INTERNAL FRICTION = 37

A = 0.17g (Max.)

 δ = ANGLE OF WALL FRICTION = 22

Kh = 0.085

Y = EFFECTIVE UNIT WEIGHT = 120 pcf

Kv - 0

CONSTRUCTION MASS **TANDARDS**

DENSE FOUNDATION SOILS, EVEL BACKFILL, SURCHARGE

APRIL DATE OF DRAWING NUMBER 2004 **JUSSI** 0

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## 7,000 7,500 8,000 8,500 9,000 9,000 9,000 10,000 11,000 11,000 11,000 12,000 12,000 2,0								TAE	LE OF DIA	ENSIONS /	AND REINF	ORCING S	TEEL.					
T 2.000 2.00		14.0	15.0	16,0	17.0	18.0	19.0	20.0	21,0	22.0	23,0	24.0	25,0	26.0	27.0	28.0	29.0	30.0
A 2.500 2.500 2.500 2.500 3.000 3.000 3.000 3.000 3.500 3.500 3.500 4.000 4.000 4.000 4.500 4.500 B 2.500 2.583 2.667 2.750 2.833 2.917 3.000 3.883 3.167 3.250 3.333 3.417 3.500 3.583 3.667 3.708 C 2.000 2.417 2.833 3.250 3.167 3.083 3.500 3.917 3.833 4.250 4.167 4.083 4.500 4.917 4.833 4.792 L 2.400 2.600 4.200 4.500 6.400 6.800 7.200 8.500 10.000 10.500 11.000 13.800 14.400 15.000 15.600 15.500 1 MM 1.000	The second secon	7.000	7.500	8.000	8.500	9.000	9,000	9.500	10.000	10.500	11.000	11,000	11,500	12.000	12.500	13.000	13.000	13.500
B 2.500 2.583 2.667 2.750 2.833 2.917 3.000 3.083 3.167 3.250 3.333 3.417 3.500 3.583 3.667 3.708 2.000 2.417 2.833 3.250 3.167 3.083 3.500 3.917 3.833 4.250 4.167 4.083 4.500 4.917 4.833 4.792 2.000 2.417 2.833 3.250 3.167 3.083 3.500 3.917 3.833 4.250 4.167 4.083 4.500 4.917 4.833 4.792 2.000 2.600 4.200 4.500 6.400 6.800 7.200 9.500 10.000 10.500 11.000 13.800 14.400 15.000 15.500 15.500 1.000 1.250 1.250 1.250 1.250 1.250 1.250 1.500 1.917 1.917 2.500 2.500 2.500 2.500 3.167 4.083 4.083 3.167 4.083 4.083 3.167 4.000 1.		2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	,	1	2.500
C 2.000 2.417 2.833 3.250 3.167 3.083 3.500 3.917 3.833 4.250 4.167 4.083 4.500 4.917 4.833 4.792 L 2.400 2.600 4.200 4.500 6.400 6.806 7.200 9.500 10.000 10.500 11.000 13.800 14.400 15.000 15.500 15.900 1 1.000 1.0	A	2,500	1		1	1		1	3.000		3.500			1	1		£	4,500
L 2.400 2.600 4.200 4.500 6.400 6.800 7.200 9.500 10.000 10.500 11.000 13.800 14.400 15.000 15.600 15.900 1 15.900 1 10.000 1.250 1.	8	•	£			1	1	1	1	1				I	1		•	3.792
## 1.000	<u> </u>	2.000	2.417	2.833	3,250	3.167	3,083	3.500	3.917	3.833	4.250	4.167	4,083	4,500	4.917	4.833	4.792	5.208
M		2,400	2.600	4.200	4,500	6,400	6.800	7.200	9,500	10.000	10,500	11.000	13.800	14.400	15.000	15.600	15,900	16.500
N 1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.25	Marie Control		3		ł	1		,	1	3	1				1	1	?	4.083
HOOK 0.833 1.000 1		1.000	1.000	1.000	1	1	1.000	1.000	1.000	1.000	1,000	ŧ	1.250	1.250	1.250	1.250	1.250	1.250
Abers 5@12 6@12 6@12 6@12 6@12 7@12 8@12 8@12 8@12 9@12 10@12 10@12 10@12 10@12 11@12 11 8bers 4@12 4@12 4@12 4@12 4@12 4@12 4@12 4@12	1 P 1 1 1 1 1 1	1.250	1,250	1,250	1,250	1.500	1,500	1.917	1.917	2.500	2.500	2.500	3,167	4,083	4.083	5,900	4.083	4.083
Bibers 4@12 4@12 4@12 4@12 4@12 4@12 4@12 4@12	ноок	0,833	1.000	1.000	1.000	1.000	1.167	1.333	1.333	1.333	1.583	1.583	1,833	1.833	1.833	1.833	2.000	2.000
Bibers 4@12 4@12 4@12 4@12 4@12 4@12 4@12 4@12																		<u> </u>
Chars 4 @ 18 4 @ 18 4 @ 16 5 @ 18 5 @ 18 5 @ 18 6 @ 18 7 @ 18 7 @ 18 8 @ 18 8 @ 18 9 @ 18 10 @ 18 10 @ 18 9 @ 18 10 @ 18 5 @ 18																		11@12
Dispars 4 @ 18 4 @ 18 4 @ 18 4 @ 18 4 @ 18 4 @ 18 4 @ 18 4 @ 18 4 @ 18 4 @ 18 4 @ 18 5																		4@12
Ebars 5@18 5@18 5@18 5@18 6@18 6@18 6@18 7@18 7@18 8@18 8@18 8@18 9@18 10@18 10@18 11@18 10@18 11 Quantities of Materials Stem Concrete (yat 770) 0.9 0.9 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 2.0 2.1 2.2 2.4 2.5 2.6	7 9777 6 6 6 6 7 1																	10@18
Quantities of Materials Stem Concrete (ynt 71) 0.9 0.9 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 2.0 2.1 2.2 2.4 2.5 2.6	C 77777																	5 @ 18 10 @ 18
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									Quan	tities of Ma	terials							
Footing Concrete (nd 7/10) 0.5 0.6 0.6 0.6 0.7 0.7 0.7 0.7 0.8 0.8 0.8 0.9 0.9 0.9 1.0 1.2	Stem Concrete (yd 1/ft)	0.9	0.9	1.1	1,2	1.3	1.4	1.5	1.6	1.7	1.8	2.0	2.1	2.2	2.4	2.5	2.6	2.7
	Footing Concrete (yd 1/ft)	0,5	0.6	0,6	0.6	0.7	0.7	0.7	0.7	9.8	0.8	8,0	0.9	0.9	0.9	1,0	1.2	1.3
Steel (II)/ft) 76 86 96 104 118 133 161 182 198 233 240 307 340 360 388 412	Steel /lib/fti	76	86	96	104	118	133	161	182	198	233	240	307	340	360	388	412	438
	Control of the contro		L,		ł		· · · · · · · · · · · · · · · · · · ·	L	****	· · · · · · · ·								
Maximum Soli Bearing Pressure									Maximum :	Soli Bearin _t	g Pressure							

Notes:

4591

1. All dimensions are in feet, unless specified otherwise.

4811

5491

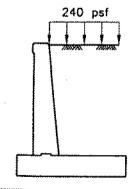
- 2. Specings of reinforcing bars are in inches.
- 3. Designer must confirm design parameters with Geotechnical Engineer prior to selecting wall for site.

ASSUMED DESIGN PARAMETERS

5752

6018

DENSE FOUNDATION SOIL, LEVEL BACKFILL, SURCHARGE



Q_{mex} (psf)

4071

4328

BACKFILL LOADING CONDITIONS:

4860

- LEVEL BACKFILL;
- 240 psf LIVE LOAD SURCHARGE,
- BACKFILL SOIL PROPERTIES:
 - TYPE: GRAVEL BORROW FOR BACKFILLING STRUCTURES AND PIPES
 - Ø = ANGLE OF INTERNAL FRICTION = 37"
 - δ = ANGLE OF WALL FRICTION = 22"
 - Y = EFFECTIVE UNIT WEIGHT = 120 pcf

3. FOUNDATION SOIL PROPERTIES:

5945

q = FACTORED BEARING CAPACITY = 9400 psf

6208

6917

6833

7090

7352

- FRICTION FACTOR = 0.57
- SLOING PERFORMANCE FACTOR FOR SLIDING 0.80
- 4. SEISMIC LOADING:
- - A = 0.17g (Max.)
 - Kh = 0.085
 - Ky = 0

5. REINFORCED CONCRETE:

F_C = 4000 psi

7271

8079

8332

 $F_{V} = 60000 \text{ psi}$

STANDARD	CONSTRU	MASSSFIII
SGS	CTION	IGHWAY

RETAINING

SLOPING

BACKFILL

FOUNDATION

APRIL DRAWING NUMBER 305.4. 2004 0

							TAL	LE OF DIM	ENSIONS /	AND RENF	ORCING ST						
	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0	29.0	30.0
W	10,000	11.000	11.500	13,000	14.000	15.000	15.500	16.500	17.500	18.500	20.000	20.500	22.000	23.000	24.000	25.000	26.000
ыка <u>п</u> . 1 н т .	2.000	2.000	2.000	2.500	2.500	3.000	3.000	3.500	3.500	4.000	4.000	4.500	4,500	5.000	5.500	5.500	6.000
J, J, S, J, J, A,	1.000	1.000	1,000	2.000	2.500	2.500	2.500	3,000	3.500	4.000	5.000	5.000	6,000	6.500	7.900	7.500	8.000
B	2.500	2.583	2.667	2.708	2.792	2.833	2.917	2,958	3.042	3.083	3.167	3.208	3.292	3.333	3.375	3.458	3.500
	6,500	7.417	7.833	8.292	8.708	9.667	10,083	10.542	10.958	11,417	11.833	12.292	12.708	13.167	13.625	14.042	14.500
L	3.600	3,900	5.600	5.800	6.200	6.400	8.500	8.750	9.250	9.500	10.000	10.250	10,750	13,200	13.500	14.100	14.400
M .	4.083	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5,000	5,000	5.000	5.000	5.000	5.000	5,000
THE SALEN SALES	1.000	1.250	1.250	1.250	1.500	1.500	1.500	1.917	1,917	1.917	1,917	1.917	2.500	2.500	3.167	3.167	3,167
P	1.000	1.000	1.000	1.000	1.250	1.000	1.250	1.250	1.500	1.500	1.917	1.917	2,500	2.500	2.500	3.167	3,167
ноок	1.000	1.167	1.167	1.167	1.333	1.333	1.583	1.583	1.833	1.833	2.000	2.000	2.000	1.583	1.583	1.583	1.583
Abers	6@12	7@12	7 @ 12	7@12	8@12	8@12	9@12	9 @ 12	10 @ 12	10 @ 12	11 @ 12	11 @ 12	11@12	9@6	9@6	9@6	9@6
B bars	4 @ 12	4@12	4@12	4@12	4@12	4@12	4@12	4@12	4 @ 12	4 @ 12	4@12	4@12	4@12	4@12	4@12	4@12	4@12
Chars	10 @ 18	11 @ 15.5	11@13	11 @ 14.5	11 @ 12.5	11 @ 11.5	11 @ 10	11 @ 10.5	11@9	11 @ 9	11@8	11@8.5	11 @ 7.5	11 @ 7.5	11 @ 7.5	11 @ 6.5	11@6.
D bars	4 @ 18	5@18	5@18	5 @ 18	6@18	5 @ 18	6@18	7@18	7@18	7 @ 18	7@16	7@16	8 @ 18	8 (0) 18	9@18	9@18	9@18
Ebars	4@18	4@18	4@18	4@18	5@18	4@18	5@18	5@18	6 @ 18	6@18	7@16	7@16	8@18	8@18	8 @ 18	9@18	9 @18
	Quantities of Materials																
Stern Concrete (yel /ft)	0.9	1.0	1.1	1.1	1.2	1,3	1,4	1.4	1.6	1.6	1.7	1.8	1.9	2.0	2.2	2.2	2.2
Footing Concrete (yd '/fi)	0.7	8.0	0.9	1.2	1.3	1.7	1,7	2.1	2.3	2.7	3.0	3.4	3.7	4.3	4.9	5.1	5.8
Steel (lb/ft)	126	158	173	189	219	309	351	379	422	440	500	516	557	588	625	653	664

Notes:

5737

1. All dimensions are in feet, unless specified otherwise.

4998

5371

- 2. Spacings of reinforcing bars are in inches.
- 3. Designer must confirm design parameters with Geotechnical Engineer prior to selecting wall for site.

5816

5814

ASSUMED DESIGN PARAMETERS

LOOSE FOUNDATION SOIL, SLOPING BACKFILL

1. BACKFILL LOADING CONDITIONS:

5064

3. FOUNDATION SOIL PROPERTIES:

5. REINFORCED CONCRETE:

2H:1V SLOPING BACKFILL

FRICTION FACTOR # 0.50

≈ 4000 psi

5667

5687

5797

2. BACKFILL SOIL PROPERTIES:

5387

5847

5473

5567

= 60000 psi

TYPE: GRAVEL BORROW FOR BACKFILLING STRUCTURES AND PIPES

4. SEISMIC LOADING:

Maximum Soil Bearing Pressure

5771

SLONG = PERFORMANCE FACTOR FOR SLIDING = 0.80

q. = FACTORED BEARING CAPACITY = 6000 psf

 θ = ANGLE OF INTERNAL FRICTION = 37°

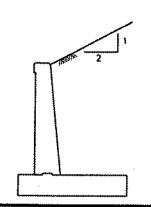
A = 0.17g (Mox.)

Kh # 0.085

8 * ANGLE OF WALL FRICTION = 22"

Y = EFFECTIVE UNIT WEIGHT = 120 pcf

Kv = 0



Q_{max} (psf)

4918

5231

CANTILEVER BACKFILL, FOUNDATION SOILS, ACKFILL, SURCHARGE RETAINING

APRIL 2004 DRAWING NUMBER	

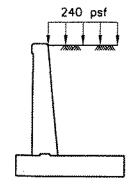
	TABLE OF DIMENSIONS AND REINFORCING STEEL.																
H	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0	26.0	27,0	28.0	29.0	30.0
W	7.500	8.000	8.000	8.500	9,000	9,500	10.000	10.500	11,000	11.500	12,000	13.000	13.500	14.000	15.000	15.500	16.000
T	2,000	2,000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.500	2.500	2.500	2.500
A	1.500	1.500	1.750	2.000	2.500	2.500	2.500	3,000	3.000	3.500	3.750	4.250	4.500	5.000	5,500	5.500	6.000
B	2.500	2.583	2.667	2.750	2.833	2.917	3,000	3.083	3.167	3.250	3,333	3.417	3.500	3.542	3.625	3.750	3.87
C	3.500	3.917	3.583	3.750	3.667	4.083	4.500	4.417	4,833	4.750	4,917	5.333	5.500	5.458	5.875	6.250	6.12
<u>.</u>	2.400	2.600	4.200	4.500	6.400	6.800	7.200	9.500	10.000	10.500	11.000	11.500	14,400	14.700	15,300	15.900	16.50
M	1.250	1.500	1.500	1.500	1.500	1.917	2.500	2.500	3,167	3.167	3.167	4.083	4.083	3,167	4.083	5.000	5.00
N	1.000	1,000	1.000	1.000	1.000	1.000	1.000	1.000	1.250	1.250	1.250	1.250	1.500	1.250	1.500	1.500	1,50
P	1,000	1,000	1.000	1.000	1.250	1.250	1,500	1,917	1.917	2.500	2.500	3.167	4.083	3.167	4.083	4.083	5.00
HOOK	0.833	0.833	1.000	1.000	1.167	1.167	1.167	1.333	1.333	1.583	1.583	1.583	1,833	1.833	2.000	2.000	2.00
A bars	5 @ 12	5@12	6@12	6 @ 12	7@12	7@12	7@12	8@12	8 @ 12	9 @ 12	9 @ 12	9@12	10 @ 12	10 @ 12	11 @ 12	11 @ 12	11@
8 bars	4@12	4@12	4@12	4@12	4@12	4 @ 12	4@12	4 @ 12	4 @ 12	4@12	4@12	4@12	4@12	4 @ 12	4 @ 12	4@12	4@1
C bars	5@18	6@18	6@18	6 @ 18	6@18	7@18	8@18	8 62 18	9 @ 18	9@18	9 @ 18	10 @ 18	10 @ 16	9 @ 16	10 @ 18	11 @ 18	11@
D bars	4@18	4 @ 18	4@18	4@18	4@18	4@18	4@18	4@18	5@18	5@18	5@18	5@18	6@18	5@18	6 @ 18	6@18	6@1
E bars	4@18	4 @ 18	4@18	4@18	5 @ 18	5@18	6@18	7@18	7@18	8@18	8@18	9@18	10@18	9@18	10@18	10@18	11@
								Quan	tities of Ma	teriais							
Stem Concrete (yd³/ft)	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	2.0	2.1	2.1	2.3	2.4	2.6	2.7
ooting Concrete (yd '7t)	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.8	0.8	0.9	0,9	1.0	1.0	1.3	1.4	1,4	1.5
Steel (lb/ft)	79	86	101	106	130	141	157	191	211	246	257	287	365	343	435	463	492
**************************************	······································							Meximum :	Soil Bearing	g Pressure							
Q ,,,,, (psf)	4318	4614	5111	5210	5133	5412	5693	5616	5893	5824	5929	5558	5670	5733	5440	5695	5687

Notes:

- 1. All dimensions are in feet, unless specified otherwise.
- 2. Spacings of reinforcing bars are in inchas.
- 3. Designer must confirm design parameters with Geotechnical Engineer prior to selecting wait for site.

ASSUMED DESIGN PARAMETERS

LOOSE FOUNDATION SOIL, LEVEL BACKFILL, SURCHARGE



- BACKFILL LOADING CONDITIONS:
 - LEVEL BACKFILL;

240 psf LIVE LOAD SURCHARGE.

- **BACKFILL SOIL PROPERTIES:**
 - TYPE: GRAVEL BORROW FOR BACKFILLING STRUCTURES AND PIPES
 - 0 = ANGLE OF INTERNAL FRICTION = 37
 - δ = ANGLE OF WALL FRICTION = 22'
 - Y = EFFECTIVE UNIT WEIGHT = 120 pcf

- 3. FOUNDATION SOIL PROPERTIES:
 - q = FACTORED BEARING CAPACITY = 6000 psf

FRICTION FACTOR = 0.5

SLORG = PERFORMANCE FACTOR FOR SLIDING = 0.80

- 4. SEISMIC LOADING:

A = 0.17g (Mox.)

Kh # 0.085

Ky w O

5. REINFORCED CONCRETE:

F_C' = 4000 psi

Fy = 60000 psi

SLOPING

BACKFILL

ည ၁	DRAWING	APRIL 2
'n	Z	200
D	NUMBER	4
	~	

	TABLE OF DIMENSIONS AND REINFORCING STEEL																
	14.0	15.0	16.0	17.0	18.0	19.0	20.0	71.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0	29.0	30,0
W	8,500	9,000	9.000	9.500	10,000	10,500	11.000	11.500	12.000	13.000	13,500	14.000	14,500	15,000	15.500	16.000	16,500
T	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.500	2.500	2.500	2.500	2.500	2.500	3.000	3.000	3.500
	1.500	2,000	2.500	3.000	3.000	3,500	3.500	4.000	4.500	4.500	4.500	5,000	5.000	5.500	5.500	6.000	6.000
8	2.500	2.583	2.667	2.750	2.833	2.917	3.000	3.083	3.125	3.208	3.292	3.375	3.458	3.542	3.583	3.667	3.708
parta a Communication	4,500	4,417	3.833	3.750	4.167	4.983	4,500	4.417	4,375	5.292	5.708	5.625	6.042	5.958	6,417	6.333	6.792
																	<u> </u>
4	3.600	3.900	5.600	6.000	8.000	8.500	9.000	11.400	11.700	12.300	12.900	13.500	16.450	17.150	17.500	18.200	18.550
#	1.917	1,917	1.917	1.917	1.917	1.917	2.500	2.500	1.917	3.167	4,083	4.083	5.000	5.000	5.000	5.000	5,000
N	1.000	1.000	1.000	1,000	1.000	1.000	1.000	1.250	1.000	1.250	1.250	1.250	1.250	1.250	1.500	1.250	1.500
P	1.000	1.000	1.250	1,917	1.917	2.500	2.500	3.167	3.167	3.167	4.083	4.083	5.000	5.000	5.000	5,000	5,000
HOOK	1,000	1.167	1.167	1,333	1.333	1.583	1,583	1.833	1.833	2.000	2.000	1.583	1,583	1.833	1,833	1,833	1.833
		740.40	7 43 45	0.040	0.00	0.40.20		10.40.40	40.40.40	44 49 49	44 60 40	0.40.0	0.00	40.45.0	40.40.C	40.40.6	40.49.6
A bars B bars	6@12	7@12	7@12	8@12	8@12	9@12	9@12	10 @ 12	10@12	11@12	11 @ 12	9@6	9@6	10@6	10@6	10.006	10 @ 6
Chars	4@12	4@12	4@12 7@18	4 @ 12 7 @ 18	4@12	4@12 7@17	4@12 8@18	4@12	4 @ 12	4 @ 12	4@12 10@18	4@12 10@18	4@12 11@18	4@12 11@18	4 @ 12 11 @ 18	4@12 11@18	4@12 11@18
D bars	7 @ 18 4 @ 18	7@18 4@18	4@18	4@18	7@18 4@18		4 @ 18	8@18	7 @ 17 4 @ 18	9 @ 18 5 @ 18	5@18	5@17	5@18	5@16	6@18	5@15	6@17
Ebars	4@18	4@18	5@18	7 @ 18	7@18	4@18 8@18	8@18	5@18 9@18	9@18	9 @ 18	10@18	10 @ 17	11 @ 18	11 @ 16	11 @ 18	11 @ 15	11 @ 17
Maria Ma	<u> </u>					<u> </u>									¥		
								Quant	ities of Ma	terials							
Stem Concrete (yd 7ft)	0.9	0.9	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.2	2.3	2.4	2.5	2.7
Footing Concrete (yd 3/ft)	0.6	0.7	0.7	0.7	0.7	0.8	8.0	0.9	1.1	1.2	1.3	1.3	1.3	1.4	1.7	1.8	2.1
Steel (lb/ft)	98	120	125	148	164	197	213	272	276	342	379	382	446	503	543	558	580

Notes:

5481

1. All dimensions are in feet, unless specified otherwise.

6053

6103

- 2. Spacings of reinforcing bars are in inches.
- 3. Designer must confirm design parameters with Geotechnical Engineer prior to selecting wall for site.

6626

6677

ASSUMED DESIGN PARAMETERS

ROCK FOUNDATION, SLOPING BACKFILL

- 1. BACKFILL LOADING CONDITIONS:
- 3. FOUNDATION SOIL PROPERTIES:

FRICTION FACTOR = 0.70

7053

7562

7625

8134

8197

5. REINFORCED CONCRETE:

2H:1V SLOPING BACKFILL

5530

- q = FACTORED BEARING CAPACITY = 20000 psf
- * 4000 psi F_V = 60000 psi

8802

8870

9475

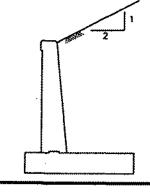
2. BACKFILL SOIL PROPERTIES:

- # PERFORMANCE FACTOR FOR SUDING = 0.80
- TYPE: GRAVEL BORROW FOR BACKFILLING STRUCTURES AND PIPES
- 4. SEISMIC LOADING:

Maximum Soil Bearing Pressure

6838

- 0 = ANGLE OF INTERNAL FRICTION = 37
- A = 0.17g (Max.)
- δ = ANGLE OF WALL FRICTION = 22
- Kh = 0.085
- Y = EFFECTIVE UNIT WEIGHT = 120 pcf
- Ky = 0



Q_{mex} (psf)

5123

5161

STANDARDS	CONSTRUCTION	MASSCHIGHWAY
		CAN

FOUNDATION, (FILL, SURCHARGE RETAINING

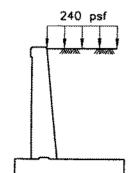
		TABLE OF DIMENSIONS AND REINFORCING STEEL																
	H	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25,0	26.0	27.0	28.0	29.0	30.0
	W	7.000	7.500	8.000	8.500	9.000	9.000	9.500	10.000	10.500	11.000	11.000	11,500	12.000	12,500	13.000	13.000	13.500
	F	2.000	2,000	2.000	2,000	2.000	2.000	2.000	2.000	2.000	2,000	2.000	2.000	2.000	2.000	2.000	2.500	2.500
	A	2.500	2,500	2.500	2.500	3,000	3.000	3.000	3.000	3.500	3.500	3.500	4.000	4.000	4.000	4.500	4,500	4.500
	8	2.500	2.583	2.667	2.750	2.833	2.917	3.000	3.083	3.167	3.250	3.333	3.417	3.500	3.583	3.667	3.708	3.792
	C	2.000	2.417	2.833	3.250	3.167	3.083	3.500	3.917	3.833	4.250	4.167	4.083	4.500	4.917	4.833	4.792	5.208
								<u> </u>								<u> </u>		
		2.400	2.600	4.200	4.500	6.400	6.800	7.200	9.500	10.000	10.500	11.000	13.800	14.400	15.000	15.600	15,900	16,500
	M	1.000	1.000	1.000	1.250	1.250	1.250	1.500	1.917	1.917	2.500	2.500	2.500	3.167	4.083	4.083	3,167	4.083
	N	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.250	1.250	1.250	1.250	1.250	1.250
	P	1.250	1.250	1.250	1.250	1.500	1.500	1.917	1.917	2,500	2.500	2.500	3.167	4.083	4,083	5.000	4.083	4.083
	HOOK	0.833	1.000	1,000	1.000	1.000	1.167	1.333	1.333	1.333	1.583	1.583	1.833	1.833	1.833	1,833	2,000	2.000
	A 4-40-01 11 11 11 11 11 11 11 11 11 11 11 11 1	W 00.40		0.004						2.5.15			48.76.46	72.57	40.65.40	40.40.40	24 63 40	44 45 45
5 1	A bars	5@12	6@12	6@12	6@12	6@12	7@12	8@12	8@12	8@12	9@12	9@12	10@12	16 @ 12	10@12	10 @ 12	11 @ 12	11 @ 12
	8 bars	4@12	4 @ 12	4@12	4@12	4@12	4@12	4@12	4@12	4@12	4@12	4@12	4@12	4@12	4@12	4@12	4@12	4@12
i i	C bars	4@18	4@18	4@16	5@18	5@18	5@18	6@18	7@18	7@18	8@18	8@18	8@18	9@18	10@18	10@18	9@18	10@18
II .	D bers	4@18	4@18	4@18	4 @ 18	4@18	4@18	4@18	4@18	4@18	4@18	4@18	5@18	5@18	5@18	5@18	5@18	5@18
	E bars	5@18	5@18	5@18	5@18	6@18	6@18	7@18	7@18	8@18	8@18	8@18	9@18	10@18	10@18	11 @ 18	10@18	10@18
									Quant	ities of Ma	terials							
Stem Co	encrete (yd ⁷ /ft)	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	2.0	2.1	2.2	2.4	2.5	2.6	2.7
Footing C	oncrete (yd³/ft)	0.5	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.8	8,0	0.8	0.9	0.9	0.9	1.0	1.2	1.3
Ste	el (lb/ft)	76	85	96	104	118	133	176	182	198	233	240	307	340	360	388	412	438
	wi (imiy		65	-50	149	110	149	110	147	140	440	540	991	940	330		716	7770
								i	Maximum S	Soil Bearing	y Pressure							
Q_n	···· (ρst)	4071	4328	4591	4860	4811	5491	5752	6018	5945	6208	6917	6833	7090	7352	7271	8079	8332

Notes:

- 1. All dimensions are in feet, unless specified otherwise.
- 2. Spacings of reinforcing bars are in inches.
- 3. Designer must confirm design parameters with Geotechnical Engineer prior to selecting wall for site.

ASSUMED DESIGN PARAMETERS

ROCK FOUNDATION, LEVEL BACKFILL, SURCHARGE



- BACKFILL LOADING CONDITIONS:
- 3. FOUNDATION SOIL PROPERTIES:

5. REINFORCED CONCRETE:

LEVEL BACKFILL:

240 psf LIVE LOAD SURCHARGE.

- q, = FACTORED BEARING CAPACITY = 20000 psf
- F_C = 4000 psi

BACKFILL SOIL PROPERTIES:

FRICTION FACTOR = 0.70

 $F_{V} \simeq 60000 \text{ psi}$

TYPE: GRAVEL BORROW FOR BACKFILLING STRUCTURES AND PIPES

8 = ANGLE OF INTERNAL FRICTION = 37

 δ # ANGLE OF WALL FRICTION # 22"

Y = EFFECTIVE UNIT WEIGHT = 120 pcf

- Ø = PERFORMANCE FACTOR FOR SLIDING = 0.80
- 4. SEISMIC LOADING:
 - - A = 0.17g (Max.)

 - Kh = 0.085
 - Ky # 0